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MAY 30 2012

Federal Communications Commission
Office of the Secretary

May 30, 2012

VIA ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
The Portals
445 12th Street, S.W.
Washington, DC 20554

Re: *Ex Parte* Communication – WT Docket 12-4

Dear Ms. Dortch:

On behalf of T-Mobile USA, Inc. ("T-Mobile"), and pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. § 1.1206, the undersigned submits this letter as a written *ex parte* communication in connection with WT Docket No. 12-4. This letter, and the Supplemental Declaration of Dennis Roberson ("Roberson Supplemental Declaration"), attached hereto as Exhibit 1, provide additional information demonstrating the invalidity of claims made repeatedly by the Applicants that Cellco Partnership d/b/a Verizon Wireless ("Verizon Wireless") has used its spectrum more efficiently than other major wireless carriers. The truth is precisely the opposite: ***when a meaningful analysis is performed to correct Verizon Wireless' overly simplistic calculation, Verizon Wireless' spectrum efficiency is seen to lag behind that of the rest of the industry, in many cases by a wide margin.***

The information herein supplements T-Mobile's previous showings in this regard in response to requests for further detail by Commission Staff at a meeting with T-Mobile personnel on May 11, 2012, at which a slide was presented summarizing and augmenting T-Mobile's previous showings on this issue.[1] In addition, this letter conclusively refutes statements on this issue made in Verizon Wireless' *ex* parte letter on behalf of itself and SpectrumCo, LLC, its members (Comcast Corporation, Time Warner Cable, Inc., and Bright House Networks LLC), and Cox TMI Wireless, LLC, in this docket ("May 2 Letter") and Verizon Wireless, SpectrumCo and Cox's *ex parte* letter of May 21, 2012 ("May 21 Letter").

[1] *See* May 15, 2012, Letter of T-Mobile to Marlene H. Dortch in this docket, regarding this meeting, and in particular slide 7 of the presentation attached thereto ("May 15 T-Mobile Letter"). For ease of reference a copy of this slide 7 is attached to Mr. Roberson's Supplemental Declaration at Attachment 1 thereto.

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Successive Refinements to Mr. Roberson's Analysis Confirm Beyond Doubt That Verizon Wireless is the *Least* Spectrally Efficient of the Four Largest Carriers

In its previous showings in this docket, T-Mobile has already shown that the spectral efficiency analysis on which Verizon Wireless bases its claim is fundamentally and fatally flawed – and that when these flaws are corrected, the analysis demonstrates that Verizon Wireless is far from the most efficient carrier.[2] Mr. Roberson's analysis in his Supplemental Declaration expands on his previous analysis in two key ways. First, he includes a comparison with the other two of the four largest carriers, adding AT&T and Sprint to his previous comparison of Verizon Wireless and T-Mobile. Further, he adds another critical variable to the analysis to reflect the fact that not only do the carriers' relative penetrations of smartphones vary (with Verizon Wireless being the laggard among national carriers) but also that the relative *usage per smartphone* is widely divergent between the carriers. As he explains:

> T-Mobile's users make the most intensive demands, averaging approximately 1700 MB per month, according to a Wall Street Journal article. This figure is 50% higher than the next highest, Sprint's 1200 MB/subscriber/month; it is nearly *twice* Verizon Wireless' figure (902) and more than twice AT&T's (724).[3]

As Mr. Roberson points out, this factor must also be considered when assessing spectral efficiency because a carrier whose smartphone users make greater *per capita* data demands is more efficient even if it otherwise serves the same number of users and has the same relative smart phone penetration. Moreover, as he notes: "[B]oth this and the smartphone mix correction are important in light of the Commission's policy of fostering broadband wireless, since together, they fairly take into account the fact that some carriers are significantly farther along than others at bringing broadband to their users."[4] Mr. Roberson also provides an Appendix containing the raw data relied on in his study, to enable the Commission to more fully understand his results.

Mr. Roberson's analysis only further underscores T-Mobile's previous showing that Verizon Wireless' so-called "spectrum efficiency" analysis is overly simplistic. As he summarizes with regard to the Top 50 wireless markets:[5]

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2 *See e.g.,* April 18, 2012 Letter of T-Mobile to Marlene H. Dortch, WT Docket No. 12-4; April 20, 2012 Letter of T-Mobile to Marlene H. Dortch, WT Docket No. 12-4; May 1, 2012 Letter of T-Mobile to Marlene H. Dortch, WT Docket No. 12-4.

3 Roberson Supplemental Declaration at para. 12, citing "Confessions of an iPhone Data Hog," *Wall Street Journal*, 27 January 2012.

4 Roberson Supplemental Declaration at para. 4.

5 His analysis excludes San Juan, Puerto Rico, since Verizon Wireless does not provide wireless service using its own network there. Roberson Supplemental Declaration at para. 5, footnote 1.

> Corrected ... for smartphone *usage* as well as mix, the analysis shows that T-Mobile, with its high per capita smartphone data usage, is the [spectrum efficiency] leader in many markets [26], with Verizon Wireless now coming in third, after Sprint. Finally, when the correction for spectrum propagation characteristics is made, Verizon Wireless leads in only two of the Top 50 markets, putting it in last place among the four largest carriers.[6]

Verizon Wireless' Attempts to Refute T-Mobile's Showings on the Differing Efficiency of Low and High-Band Spectrum Are Facially Meritless -- and Indeed Are Directly Contrary to Its Own Oft-Repeated Position

Although T-Mobile's previous submissions had already conclusively showed the speciousness of Verizon Wireless' claim as to its alleged spectrum efficiency, Verizon Wireless continues to parrot that claim as though repetition alone will lend it the truth that it otherwise lacks. Thus, in its May 2 Letter and May 21 Letter, Verizon Wireless once again repeated this claim and attempted to brush aside T-Mobile's demonstration of the fatal flaws in the Verizon Wireless analysis, but its purported criticisms of Mr. Roberson's corrections are far wide of the mark.

In both its May 2 Letter and its May 21 Letter, Verizon Wireless asserted that it would not do to recognize -- as T-Mobile had done – that different spectrum types have different propagation characteristics in assessing efficiency. This is odd, because Verizon Wireless has said exactly the opposite over and over again. For example, its Senior Vice President and Chief Technology Officer has said in so many words that "700 MHz Delivers Superior Coverage" and that Verizon Wireless has a "Spectrum Advantage" because "Lower Frequencies Drive Enhanced Performance," citing "better in-building penetration" and "increased coverage," and "more efficient use of the macro" as compared to higher frequency bands.[7] Its Chief Executive Officer, Lowell McAdam, has made similar unequivocal statements as to the superiority of 700 MHz spectrum for wireless broadband.[8] And just within the last few days, its Chief Financial Officer once again reiterated these sentiments, saying "All spectrum is not created equal for all carriers. So from our holding perspective, with the 700 contiguous megahertz spectrum that we have, that spectrum is extremely efficient. The propagation of that spectrum into buildings is very high, so you don't need as much, quote, cell splitting or build out that

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6 Roberson Supplemental Declaration at para. 14 (emphasis in original).

7 *Id.*

8 *See* Barclays Capital, Presentation of Lowell McAdam, dated May 26, 2010, at pp. 7, 8, 13; Wells Fargo Securities Technology, Media & Telecom Conference, Presentation of Tony Melone, Verizon Wireless, dated Nov. 10, 2010, at pp. 1, 12-13. Copies of the relevant excerpts from Mr. Melone's and Mr. McAdam's presentations are attached hereto as Exhibit 2. Given the number of times and variety of forums in which Verizon Wireless has taken the same position one can only believe that Verizon Wireless' sudden switch to the opposite view is one of pure convenience, and one which it can be expected to reverse again when expedient.

you would need from other types of spectrum. So from a 700 megahertz it's really efficient spectrum."[9]

Yet its May 2 and May 21 Letters seem to have been written in a different universe. In them, Verizon Wireless asserts that the Commission should simply ignore this well-established difference because "there is no objective or accepted way in which to 'weigh' various spectrum bands."[10] In fact, there is an objective method for doing so, and in his original Declaration in this proceeding, Mr. Roberson, T-Mobile's expert witness, elucidated and justified this method in considerable detail.[11] Notably, in its May 2 Letter, Verizon Wireless did not even attempt to provide any analytical basis for doubting the method described by Mr. Roberson, nor has it provided any such basis anywhere else.[12]

Verizon Wireless' Attempts to Brush Off T-Mobile's Showings on the Effects of Smartphone Penetration Reveal Its Inability to Refute Them Substantively, Inasmuch As Verizon Wireless Has Already Recognized *in This Proceeding* That Smartphones' Bandwidth Demands Are Many Times Those of Feature Phones

In its May 2 and May 21 Letters, Verizon Wireless also attacked T-Mobile's use of differing smartphone penetration levels in correcting the analysis.[13] Again, Verizon Wireless did not deny that smartphones make much greater usage demands than other

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9 Remarks of Fran Shammo, Chief Financial Officer, Edited Transcript, Verizon at Barclays Capital Global Technology, Media and Telecommunications Conference, May 23, 2012, p. 3, available at: http://www22.verizon.com/idc/groups/public/documents/adacct/barclays_vz.pdf.

10 May 2 Letter at 11; May 21 Letter at 4.

11 Declaration of Dennis Roberson, attached as Exhibit A to Reply of T-Mobile, USA, Inc. to Opposition to Petition to Deny, WT Docket No. 12-4, filed March 26, 2012 ("Roberson Declaration").

12 Verizon Wireless also blurs the distinction between weighting for purposes of the spectrum screen and weighting for purposes of the efficiency analysis. May 2 Letter at 7, 12. As T-Mobile's expert witnesses explained, these are distinct analyses engaged in for separate purposes. The first is an economic analysis of the disparate effects on competition of having a great deal of low-band spectrum versus having the same amount of high-band spectrum. The second is a technical analysis of the differing propagation characteristics of high- and low-band spectrum and their divergent effects on efficiency. *See* Declaration of Peter Cramton, attached as Exhibit C to Reply of T-Mobile, USA, Inc. to Opposition to Petition to Deny, WT Docket No. 12-4, filed March 26, 2012, at para. 15; Roberson Declaration at paras. 10-11. While the two are related (in that technical efficacy is obviously one of the factors that goes into market value and competitive effects), they do not depend on each other. Thus, for example, even if the Commission were to decide for procedural or other reasons not to weight the spectrum for purposes of calculating the screen, that would nevertheless have no bearing on the technical differences which, as Mr. Roberson showed, invalidate Verizon Wireless' over-simplistic efficiency showing.

13 May 2 Letter at 12; May 21 Letter at 4.

phones – as it could not, since its own pleading says that smartphones have as much as *35 times* the bandwidth usage of other phones. Nevertheless, Verizon Wireless argued that this undeniable fact should be ignored because: "smartphone penetration obviously changes over time and has been increasing for all providers, including Verizon Wireless. This metric also is far too fleeting to have merit."[14] This is a particularly disingenuous argument. The original Verizon Wireless "analysis" purported to compare the carriers' *historic* efficiency performances at a given moment in time. Thus, it is entirely appropriate to compare smartphone penetration at a particular moment in time, and the fact that smartphone penetration will change in the future is irrelevant. In any event, even Verizon Wireless admits that it is changing for *all providers* – and provides no reason for believing that the relative disparity between providers does not continue to exist.[15] In fact, T-Mobile's smartphone penetration has recently increased to approximately 60% of contract customers. As Mr. Roberson explains in his Supplemental Declaration, this would increase T-Mobile's efficiency rating, but because similarly updated data are lacking for other carriers, he uses T-Mobile's previous 50% number to permit an apples-to-apples -- and conservative -- comparison.[16]

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Certain information contained in the Roberson Supplemental Declaration is confidential and each page of the non-redacted version of this filing has been marked as "CONFIDENTIAL INFORMATION - SUBJECT TO PROTECTIVE ORDER IN WT DOCKET NO. 12-4." Each page of the redacted version of this filing is marked as "REDACTED - FOR PUBLIC INSPECTION." Pursuant to the Protective Order, two copies of the confidential version of this filing are being delivered to Ms. Sandra K. Danner of the Broadband Division of the Wireless Telecommunications Bureau. One copy of the confidential version and two public, redacted version of this filing are being filed with the Secretary's Office. Finally, one copy of the public redacted version of this filing is being filed electronically through the Commission's Electronic Comment Filing System. A copy of the public redacted version of Exhibit 1 hereto was also provided under separate cover to Jim Schlichting of the Commission's Staff on May 29, 2012.

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[14] May 2 Letter at 12; *see also* May 21 Letter at 4 ("Every provider's smartphone penetration obviously changes over time and has been increasing for all providers, including Verizon Wireless. Basing efficiency metrics on smartphone penetration is both highly complex and hopelessly static.").

[15] Indeed, by ignoring smartphone penetration and data demands in favor of an analysis that simply equates smartphones and feature phones, Verizon Wireless would effectively point its own analysis at an obviously obsolete historic period – the period in which *no* carrier's customers had *any* smartphones.

[16] Roberson Supplemental Declaration at Table 6, footnote 5.

Should any additional information be required with respect to this submission, please do not hesitate to contact me.

Very truly yours,

/s/ Jean L. Kiddoo

Jean L. Kiddoo
Counsel to T-Mobile USA, Inc.

Attachments:
Exhibit 1: Supplemental Declaration of Dennis Roberson
Exhibit 2: Verizon Wireless Statements on 700 MHz

cc (by hand): Sandra Danner (2 copies of Confidential Attachment)

cc (by email):

Jim Bird	Louis Peraetz
Sandra Danner	Tom Peters
Neil Dellar	Joel Rabinovitz
Angela Giancarlo	Eric Ralph
Rick Kaplan	Jim Schlichting
Zachary Katz	Austin Schlick
Evan Kwerel	Susan Singer
Paul LaFontaine	Marius Schwartz
Charles Mathias	Michael C. Smith
Kate Matraves	Joel Taubenblatt
Virginia Metallo	Thuy Tran
Paul Murray	Aleks Yankelevich

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Exhibit 1

Supplemental Declaration of Dennis Roberson

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SUPPLEMENTAL DECLARATION

OF

DENNIS ROBERSON

MAY 26, 2012

REDACTED – FOR PUBLIC INSPECTION

SUPPLEMENTAL DECLARATION

OF

DENNIS ROBERSON

MAY 26, 2012

REDACTED – FOR PUBLIC INSPECTION

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Application of Cellco Partnership d/b/a	)	
Verizon Wireless and SpectrumCo LLC	)	
For Consent To Assign Licenses	)	WT Docket No. 12-4
	)	
Application of Cellco Partnership d/b/a	)	
Verizon Wireless and Cox TMI Wireless, LLC	)	
For Consent To Assign Licenses	)	

SUPPLEMENTAL DECLARATION OF DENNIS ROBERSON

1. I, Dennis Roberson, am the Founder, President and CEO of Roberson and Associates, LLC. On March 26, 2012, I submitted a Declaration attached as Exhibit A to the Reply of T Mobile, USA, Inc. to Opposition to Petition to Deny, WT Docket No. 12-4, filed March 26, 2012. My experience and qualifications are described in that Declaration.

Summary

2. In this Supplemental Declaration, I will provide additional data and analysis to address contentions made repeatedly in this proceeding by Verizon Wireless, SpectrumCo and Cox TMI Wireless ("Applicants"), regarding Verizon Wireless' purported (but, in fact, illusory) superiority to other carriers in the efficiency with which it makes use of spectrum in providing wireless service. As in my original Declaration, I will discuss Applicants' assertion that Verizon Wireless is more spectrally efficient under two alternative metrics: the first being the ratio of ***customer connections per MHz of spectrum*** (which I refer to herein as "Metric E_1") and the second being the ratio of ***spectrum share to customer connections share*** (which I refer to herein

as "Metric E_2"). Applicants have attempted to show that, by both these measures, Verizon Wireless is more efficient in its use of the RF spectrum than other providers. I showed in my original Declaration that Applicant's analysis as to both these metrics is so flawed as to render it useless for meaningful analysis. I showed when their analysis is corrected to address merely the most obvious of these flaws, it shows that Verizon Wireless is significantly *less* efficient than T-Mobile, particularly in the most spectrally constrained top markets.

3. Under my supervision and direction, Roberson and Associates has now supplemented and further refined its analysis and comparison of the spectrum efficiency of the T-Mobile and Verizon networks in the Top-50 cellular market areas under each of these two measures. As before, we correct for several critical errors in Applicants' analysis by: (i) removing from each operator's allocation spectrum it does not yet have, (ii) analyzing the data on a market-by-market basis rather than merely in the aggregate, (iii) correcting for the different network demands imposed by smartphone users compared to featurephone users, and (iv) correcting for the relative spectrum efficiency differences between high and low-band spectrum.

4. However, we also provide a comparison with the other two of the four largest carriers, adding AT&T and Sprint to the mix. In addition, we add another important variable to the analysis: the fact that not only do the carriers' relative penetrations of smartphones vary (with Verizon Wireless lagging the others) but also the relative data usage *per smartphone* is widely divergent between the carriers. For the most accurate account, this factor, too, must be considered, for a carrier whose smartphone users make significantly greater per capita data demands will be more efficient even if it serves the same *number* of users with the same relative smartphone penetration. Moreover, both this and the smartphone mix correction are important in light of the Commission's policy of fostering broadband wireless, since together, they fairly take

into account the fact that some carriers are significantly farther along than others at bringing broadband to their users.

5. In the discussion of the analysis and results below, I describe the mathematical methods we used in making not only the corrections we previously reported, but also the new correction described above. I also present graphs and tables comparing the spectral efficiency of the Verizon, T-Mobile, Sprint and AT&T networks. Figures 1-8 compare the spectral efficiency performance of these carriers' networks in the Top 50 markets[1] using Metric E_1: subscribers per MHz of bandwidth. In these Figures, a *higher* spectral efficiency number indicates better performance. As before, our graphs, unlike Verizon's flawed analysis, properly exclude from each operator's allocation spectrum that it does not yet have.[2] Figures 9-16 then compare the efficiency of the four networks in the Top 50 markets using Metric 2: that is, the ratio of the spectrum-share to customer-connections share. In Figures 9-16, a *lower* ratio indicates better performance. In each of these analyses, we proceed in the following sequence. In each of the two groups of Figures, we first provide, as a baseline, the raw analysis results under each spectrum efficiency metric, but not calculated on an aggregate basis as in the Applicants' invalid analysis, but on a market-by-market basis and removing from each operator's allocation spectrum that it does not yet have (referred to as "Scenario 0"). Then, we correct the analysis by adjusting for the carriers' differing smartphone penetrations: i.e., the percentage of all subscribers using smartphones, and present the results making only this correction (the analysis

[1] The analysis does not include San Juan, Puerto Rico, since Verizon Wireless does not use its own network to provide service there.

[2] Although the transfer of AT&T spectrum to T-Mobile has very recently been approved, obviously T-Mobile has not yet meaningfully begun to deploy this spectrum. The data upon which our (and Verizon Wireless') analysis is based concerns periods prior to the transfer and so this "break-up" spectrum is properly counted in AT&T's column rather than T-Mobile's. We do include Sprint's BRS spectrum in its column, since Sprint's deployment of this spectrum is well under way.

making only this correction referred to as "Scenario 1"). Next we layer on the correction for the differing smartphone per capita usage rates, and present the results showing the cumulative effect of both these corrections (referred to as "Scenario 2"). Last, we overlay the adjustment for the effects on efficiency of the differing propagation characteristics of low-band and high-band spectrum and show what conclusions are reached if all three corrections are made (referred to as "Scenario 3"). In addition, we supply below a list of the references we used (which are referred to in this Supplemental Declaration by list number), as well as an Appendix containing raw data used in developing and correcting the analysis.

6. The following Tables 1 and 2 summarize the market-by-market and corrected analysis results, under each of the three correction scenarios described above, for Metrics E_1 and E_2, averaged across the top 50 CMAs, respectively. Green highlight indicates best of the four carriers for that scenario and red highlight the worst.

Scenario	Smart-phone Mix Correction	Smart-phone Data Correction	Spectrum Correction	Verizon	AT&T	Sprint	TMUS
0	No	No	No	[redacted]	9.47	[redacted]	7.72
1	Yes	No	No	10.32	[redacted]	[redacted]	9.51
2	Yes	Yes	No	[redacted]	9.42	11.04	[redacted]
3	Yes	Yes	Yes	[redacted]	12.21	18.91	[redacted]

Table 1: Metric E_1 Average Efficiency (Top 50 CMAs, excluding Puerto Rico)

Scenario	Smart-phone Mix Correction	Smart-phone Data Correction	Spectrum Correction	Verizon	AT&T	Sprint	TMUS
0	No	No	No	[redacted]	0.8405	[redacted]	1.0423
1	Yes	No	No	0.7807	[redacted]	0.8430	[redacted]
2	Yes	Yes	No	[redacted]	0.8450	0.7216	[redacted]
3	Yes	Yes	Yes	[redacted]	0.6510	0.4207	[redacted]

Table 2: E_2 Metric Average Efficiency (Top 50 CMAs, excluding Puerto Rico)

7. Another possible scenario is that presented by T-Mobile personnel to the Commission's Staff in a meeting on May 11, 2012, in particular slide 7 of the presentation made at that meeting.[3]. That slide was prepared based on our previous analysis but applies the first refinement that we have made here -- the addition of AT&T and Sprint. When it was prepared, we had not yet had the opportunity to complete our second refinement (adding smartphone usage differences); it does apply the smartphone mix and spectrum corrections. To avoid needless verbosity, we have not included that intermediate refinement in our detailed analysis here. However, it can be summarized as follows in Tables 1-A and 2-A, and is fully consistent with the conclusions we reach as to Scenarios 2 and 3 here.

Smartphone Mix Correction	Smartphone Data Correction	Spectrum Correction	Verizon	AT&T	Sprint	TMUS
No	Yes	Yes	[redacted]	17.13	16.19	[redacted]

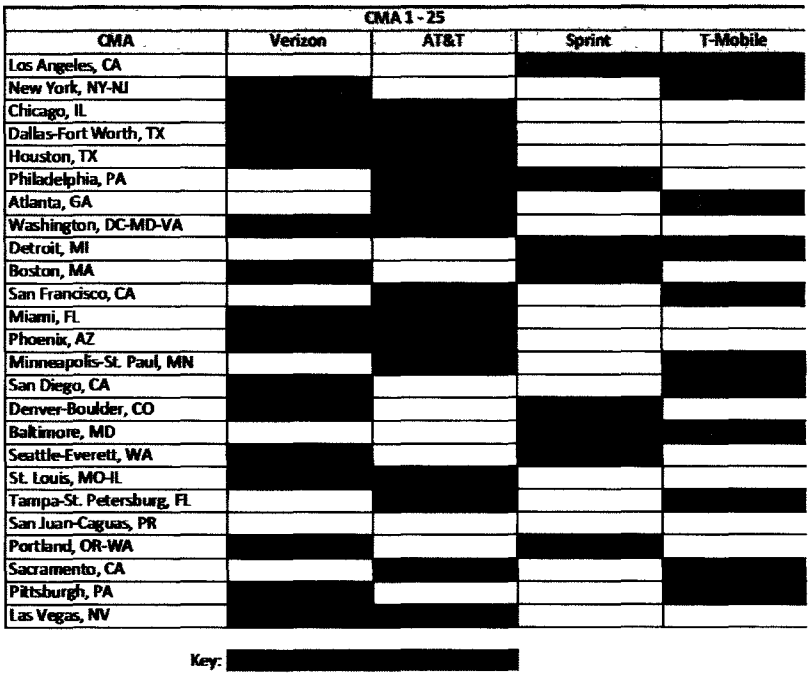
Table 1-A: E_1 Metric Average Efficiency (Top 50 CMAs, sans Puerto Rico)

Smartphone Mix Correction	Smartphone Data Correction	Spectrum Correction	Verizon	AT&T	Sprint	TMUS
No	Yes	Yes	[redacted]	0.4639	0.4915	[redacted]

Table 2-A: E_2 Metric Average Efficiency (Top 50 CMAs, sans Puerto Rico)

8.The matrices in Table 3 below show how the carriers stack up on a "Best" (green) and "Worst" (red) basis in the Top 25 CMAs under each of the three corrected scenarios under Metric 1.

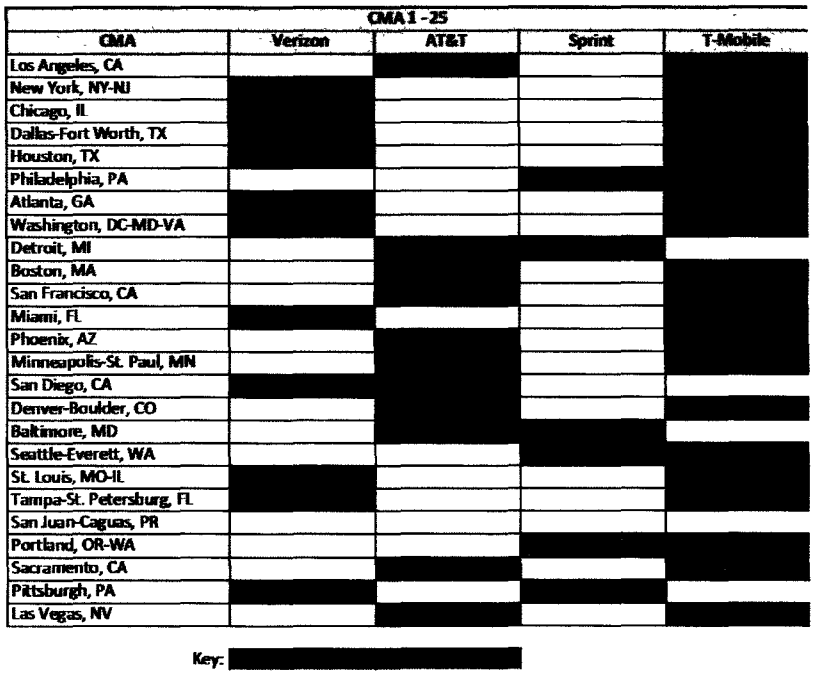
[3] *See* May 15, 2012, Letter of T-Mobile to Marlene H. Dortch in this docket, regarding this meeting, and slide 7 of the presentation attached thereto. For ease of reference a copy of this slide 7 is attached as Attachment A hereto



CMA 1 - 25				
CMA	Verizon	AT&T	Sprint	T-Mobile
Los Angeles, CA				
New York, NY-NJ				
Chicago, IL				
Dallas-Fort Worth, TX				
Houston, TX				
Philadelphia, PA				
Atlanta, GA				
Washington, DC-MD-VA				
Detroit, MI				
Boston, MA				
San Francisco, CA				
Miami, FL				
Phoenix, AZ				
Minneapolis-St. Paul, MN				
San Diego, CA				
Denver-Boulder, CO				
Baltimore, MD				
Seattle-Everett, WA				
St. Louis, MO-IL				
Tampa-St. Petersburg, FL				
San Juan-Caguas, PR				
Portland, OR-WA				
Sacramento, CA				
Pittsburgh, PA				
Las Vegas, NV				

Key:

Table 3: Scenario 1, Best and Worst Analysis by Market, Metric E_1.



CMA 1 - 25				
CMA	Verizon	AT&T	Sprint	T-Mobile
Los Angeles, CA				
New York, NY-NJ				
Chicago, IL				
Dallas-Fort Worth, TX				
Houston, TX				
Philadelphia, PA				
Atlanta, GA				
Washington, DC-MD-VA				
Detroit, MI				
Boston, MA				
San Francisco, CA				
Miami, FL				
Phoenix, AZ				
Minneapolis-St. Paul, MN				
San Diego, CA				
Denver-Boulder, CO				
Baltimore, MD				
Seattle-Everett, WA				
St. Louis, MO-IL				
Tampa-St. Petersburg, FL				
San Juan-Caguas, PR				
Portland, OR-WA				
Sacramento, CA				
Pittsburgh, PA				
Las Vegas, NV				

Key:

Table 4: Scenario 2 Summary, Best and Worst Analysis by Market, Metric E_1.

CMA 1 - 25				
CMA	Verizon	AT&T	Sprint	T-Mobile
Los Angeles, CA				
New York, NY-NJ				
Chicago, IL				
Dallas-Fort Worth, TX				
Houston, TX				
Philadelphia, PA				
Atlanta, GA				
Washington, DC-MD-VA				
Detroit, MI				
Boston, MA				
San Francisco, CA				
Miami, FL				
Phoenix, AZ				
Minneapolis-St. Paul, MN				
San Diego, CA				
Denver-Boulder, CO				
Baltimore, MD				
Seattle-Everett, WA				
St. Louis, MO-IL				
Tampa-St. Petersburg, FL				
San Juan-Caguas, PR				
Portland, OR-WA				
Sacramento, CA				
Pittsburgh, PA				
Las Vegas, NV				

Key:

Table 5: Scenario 3 Summary, Best and Worst Analysis by Market, Metric E_1.

Corrections to Efficiency Metric E_1

9. As discussed in my original Declaration, it is well known that the data and bandwidth consumed by a smartphone is many times that of a feature phone. For example, Verizon Wireless itself supports the statement that smartphones on average consume as much as 35 times the bandwidth consumed by feature phones. (See reference [2].) It is therefore clear that a carrier with a higher mix of smart to feature phones must make more efficient use of their spectrum (all other factors assumed to be equal).

10. We have analyzed this phone mix impact on spectrum usage. Mathematically, the first order correction for spectrum loading on a network, as a function simply of the percentage of all users who are smartphone users, can be expressed as follows.

$$B = Q_f + K^* Q_s ,$$

where:

B = total spectrum loading (1 = equivalent loading by only feature phones)

Q_f = proportion of feature phones

Q_s = proportion of smartphones (note $Q_f + Q_s = 1$)

K = data usage multiplication factor of smartphone over a feature phone

We have defined a spectrum use efficiency metric (E_1) which is calculated for a specific carrier, and which can be expressed as follows:

$E_{1,i} = R^* M_i / (F_i^* W_i)$, with units k-Sub/MHz, where:

M_i = Number of subscribers served by the carrier in CMA number i (k-Sub)

F_i = carrier spectrum holdings in CMA number i (MHz)

R = the relative subscriber correction factor for the carrier as compared to a reference value of 14.6 (the value for a 40%/60% smart/feature phone mix with a 35x smartphone multiplication factor with respect to a feature phone).

$$R_{Carrier} = B_{Carrier} / 14.6$$

W_i = spectrum band value correction for CMA i

i = ordered index of top 50 U.S. CMAs (Puerto Rico excluded), 1=largest CMA.

The averaged efficiency of a given carrier across all CMAs is calculated as follows.

$$E_{1,T} = \Sigma^{49}_{i=1} E_{1,i} / 49$$

11. If the subscriber phone mix is included and the smartphone multiplication factor is simply fixed at 35x, per Verizon Wireless' above-cited estimate, the following data and parameters are used (see references [4] and [5]).[4] It should be noted that these were the same factors that were used in the smartphone mix correction in my original Declaration.

[4] A smartphone multiplier of 35x implies a feature phone bandwidth use equivalent to 30 MB/Mo. which represents data and voice usage.

Subscriber Mix	Verizon	TMUS[5]	AT&T	Sprint
Smart / Feature Phone %	40% / 60%	50% / 50%	57% / 43%	66% / 34%
Avg. Smartphone Data Usage (MB/Mo.)[6]	1025	1025	1025	1025
Smartphone Multiplication Factor	35.0	35.0	35.0	35.0
$R_{Carrier}$	1.0	1.233	1.397	1.605

Table 6: Data and Parameters for Scenario 1, Metric E1 (Corrections: SP Data-NO, SP Mix-YES, Spectrum-NO)

12. However, data also exists that shows that the carriers' respective smartphone users do *not* all use the same amount of data on a per-user basis. T-Mobile's users make the most intensive demands, averaging approximately 1700 MB/subscriber/month, according to a recent Wall Street Journal article [5]. This figure is 50% higher than the next highest, Sprint's 1200 MB/subscriber/month; it is nearly *twice* Verizon Wireless' figure (902 MB/subscriber/month) and more than twice AT&T's (724 MB/subscriber/month). The analysis can – and should – be further corrected for this difference. Thus, if the subscriber phone mix is included and the smartphone multiplication factor is varied to reflect these per carrier basis differences, the following data and parameters are used (see references [4] and [5]):

Subscriber Mix	Verizon	TMUS	AT&T	Sprint
Smart / Feature Phone %	40% / 60%	50% / 50%	57% / 43%	66% / 34%
Avg. Smartphone Data Usage (MB/Mo.)	902	1700	724	1200
Smartphone Multiplication Factor	30.80	58.05	24.72	40.98
$R_{Carrier}$	0.885	2.020	0.995	1.876

Table 7: Data and Parameters for Scenario 2, Metric E1 (Corrections: SP Data-YES, SP Mix-YES, Spectrum-NO)

[5] We understand that T-Mobile's smartphone penetration has more recently increased to approximately 60% of contract customers. However, since we do not have such recent data for all carriers, we use the 50% factor for T-Mobile here to permit an apples-to-apples comparison. Note that T-Mobile's efficiency measure here would *increase* considerably if we used the 60% number, so our approach is also conservative.

[6] This constant value of 1025 MB/Mo. was calculated as the aggregate monthly smartphone traffic divided by the total number of smartphone subscribers across the four carriers based on the information contained in references [4] and [5].

13. The results of our corrected analysis under Metric E_1 are shown graphically in Figures 1-8 below. Each of the four scenarios is represented by two graphs, the first for the Top 25 CMAs (except Puerto Rico) and the second for CMAs 26-50. The test of Verizon Wireless' claim that it is the most efficient user of spectrum can be tabulated as follows:

Top 50 Markets -- BEST in Market	TMUS	Verizon	AT&T	Sprint
Scenario 0 (Uncorrected Market-by-market)	2	25	22	0
Scenario 1 (Smartphone Mix Correction Only)	4	14	29	2
Scenario 2 (Smartphone Mix and Usage Corrections Only)	26	9	4	10
Scenario 3 (Smartphone Mix and usage and Spectrum Corrections),	34	2	3	10

Table 8: Metric E_1 Best by Market (Top 50 CMAs, excluding Puerto Rico)

14. As can readily be seen, *only* in the uncorrected market-by-market analysis does Verizon efficiency match the efficiency of the other carriers. Making even the simplest correction -- that for smartphone mix -- puts Verizon Wireless far behind AT&T in the number of Top 50 markets in which it leads. Corrected further for smartphone *usage* as well as mix, the analysis shows that T-Mobile, with its high per capita smartphone data usage, is the leader in many markets, with Verizon Wireless now coming in third, after Sprint. Finally, when the correction for spectrum propagation characteristics is made, Verizon Wireless leads in only two of the Top 50 markets, putting it in last place among the four largest carriers. Because these results are disaggregated by market, they are more revealing than the averaged results set forth in Table 1 above, but both trend in the same direction.

Efficiency Plots

Scenario 0, Metric E_1: Corrections: SP Data-No; SP Mix-No; Spectrum-No

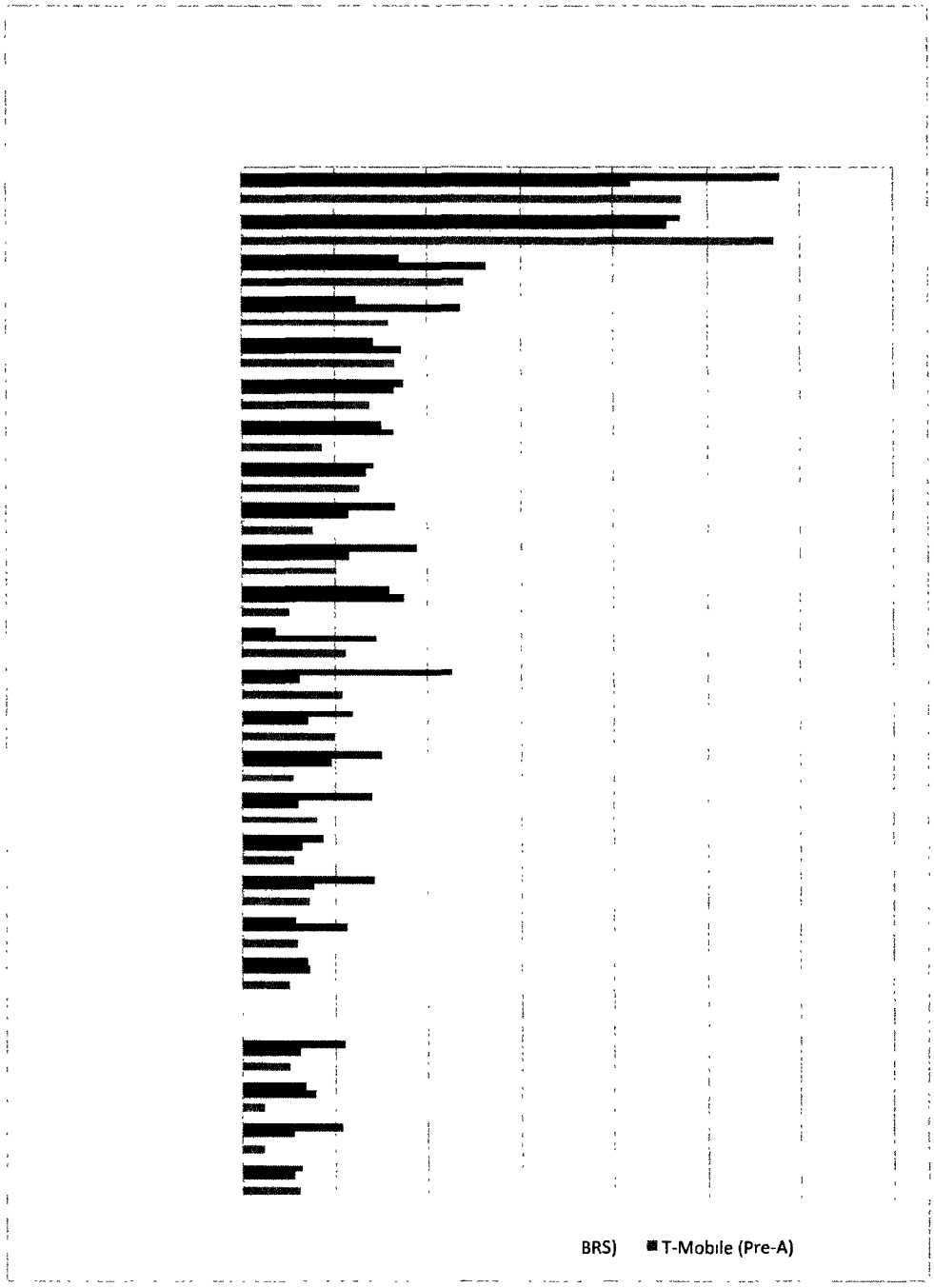


Figure 1: Scenario 0, Metric E_1 (Corrections: SP Data-NO, SP Mix-NO, Spectrum-NO)

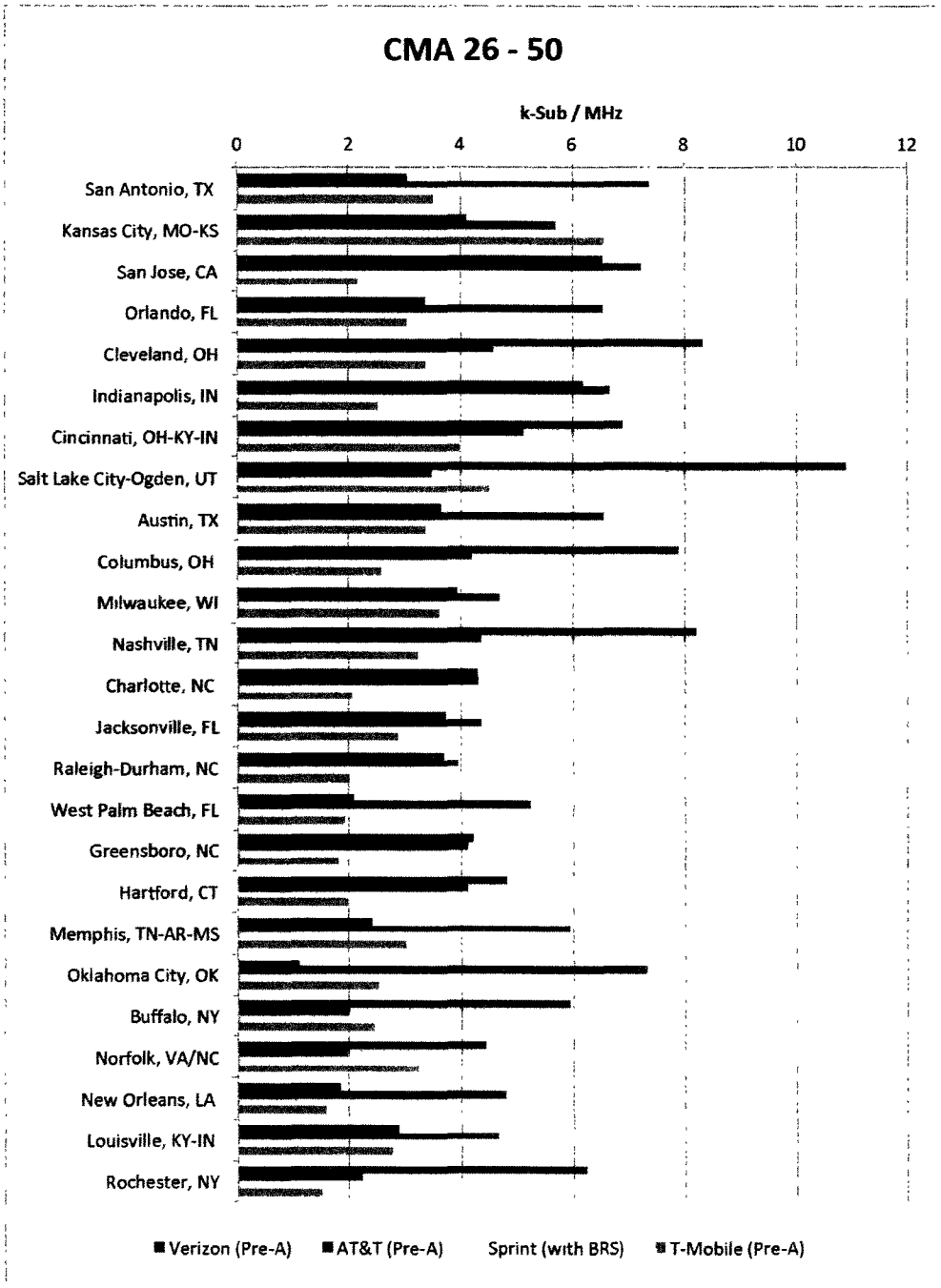


Figure 2: Scenario 0, Metric E_1 (Corrections: SP Data-NO, SP Mix-NO, Spectrum-NO)

Scenario 1, Metric E_1: Corrections: SP Data-No; SP Mix-Yes; Spectrum-No

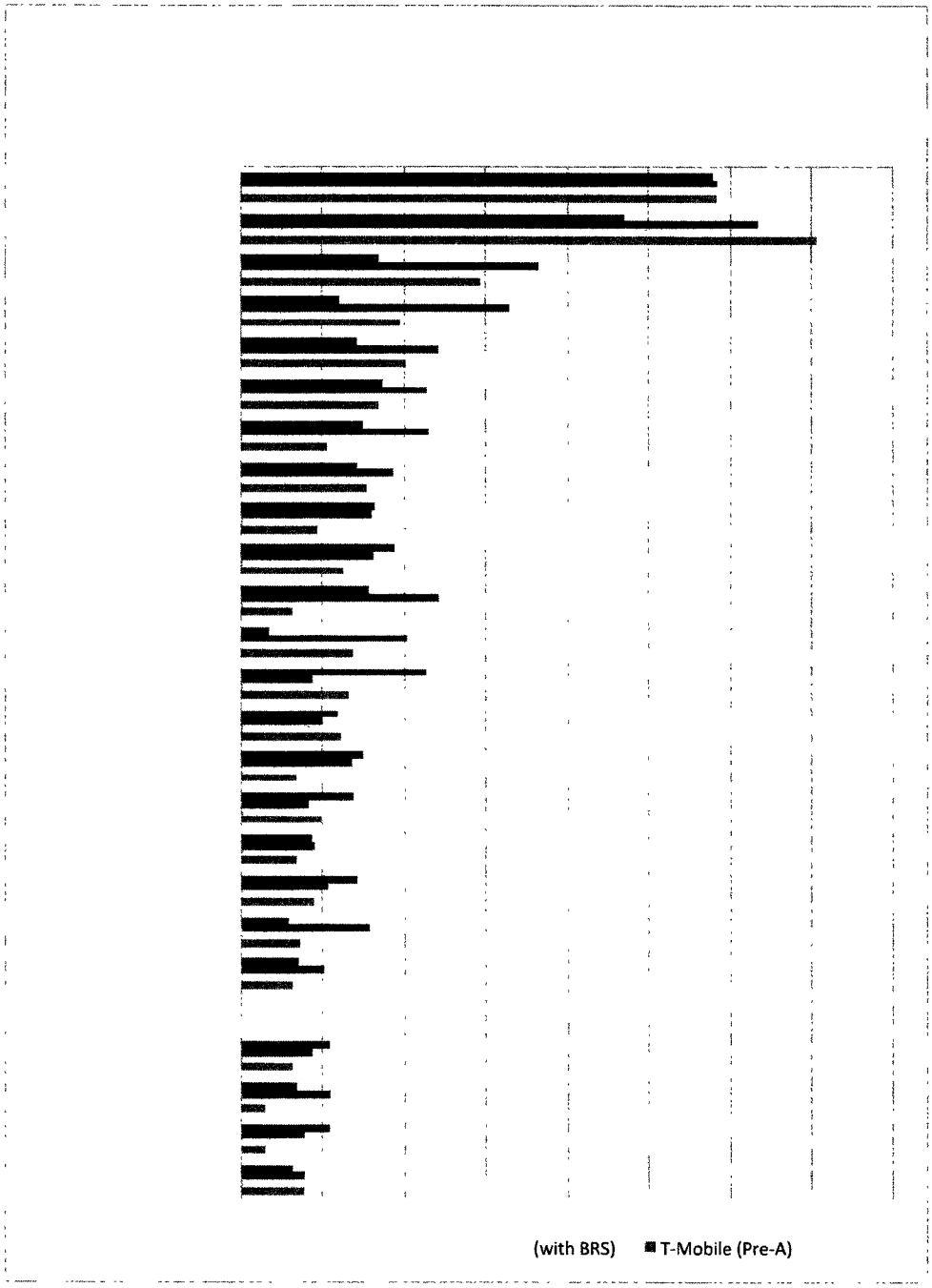


Figure 3: Scenario 1, Metric E_1 (Corrections: SP Data-NO, SP Mix-YES, Spectrum-NO)

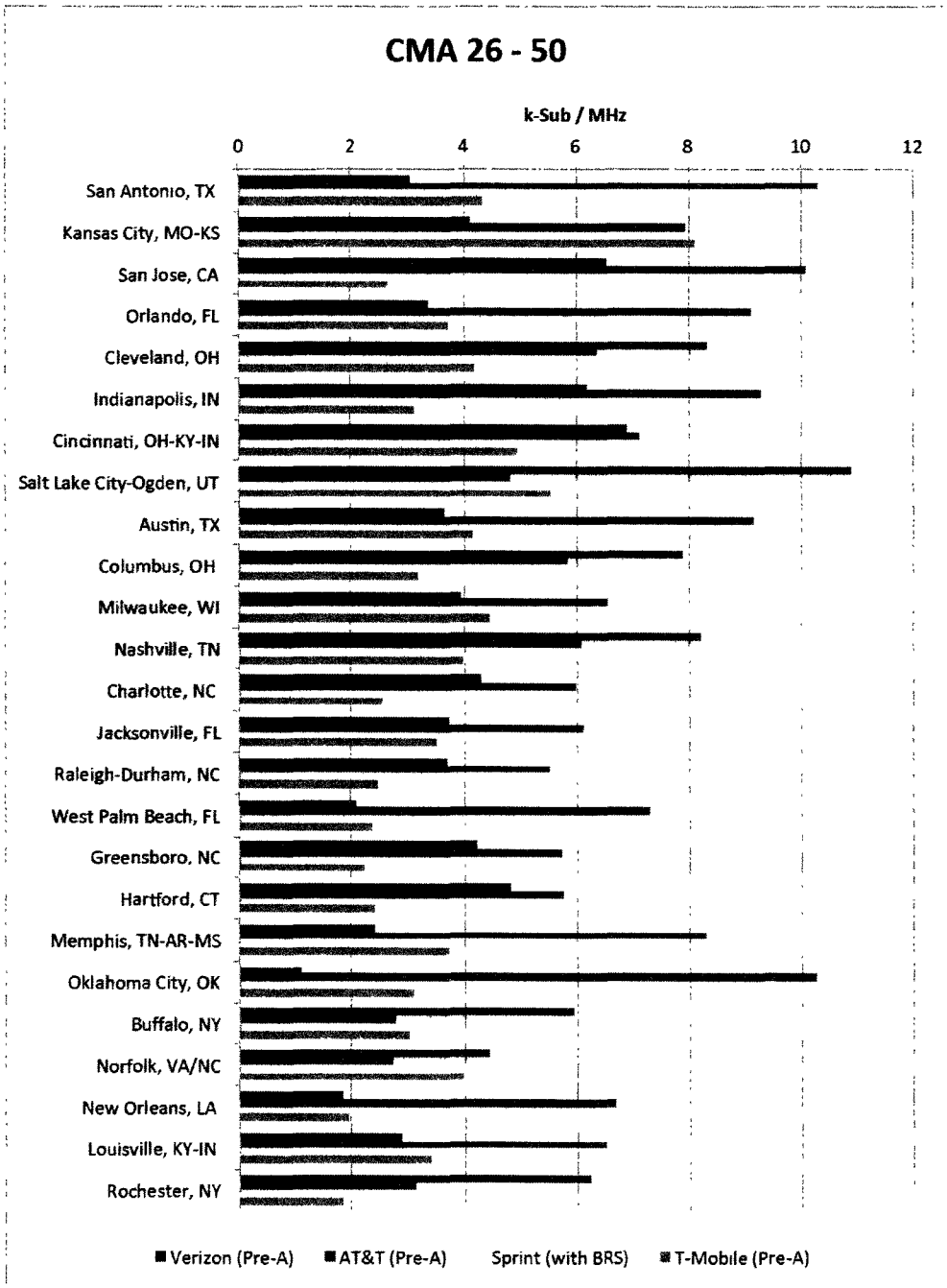


Figure 4: Scenario 1, Metric E_1 (Corrections: SP Data-NO, SP Mix-YES, Spectrum-NO)

Scenario 2, Metric E_1: Corrections: SP Data-Yes; SP Mix-Yes; Spectrum-No

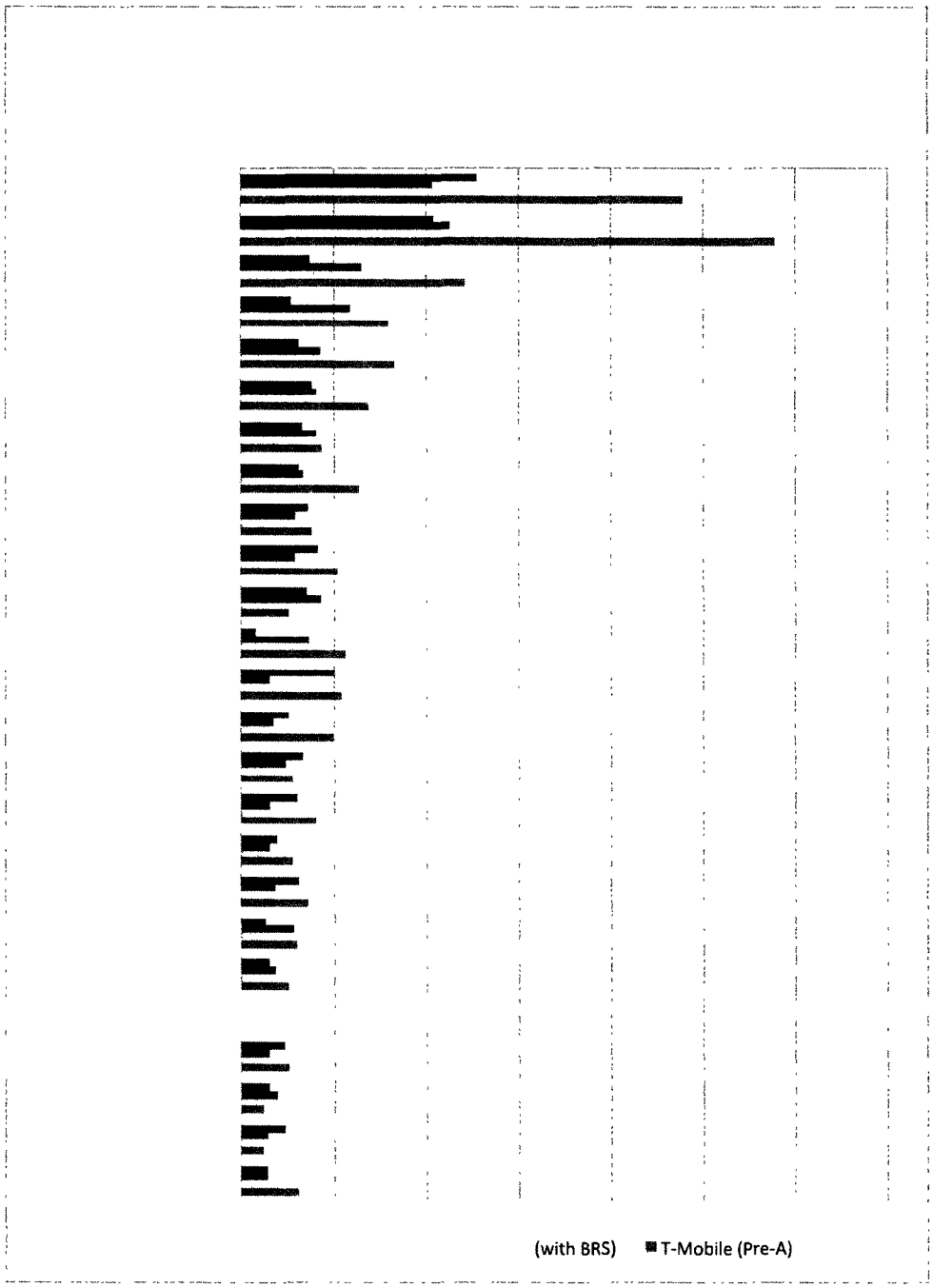


Figure 5: Scenario 2, Metric E_1 (Corrections: SP Data-YES, SP Mix-YES, Spectrum-NO)

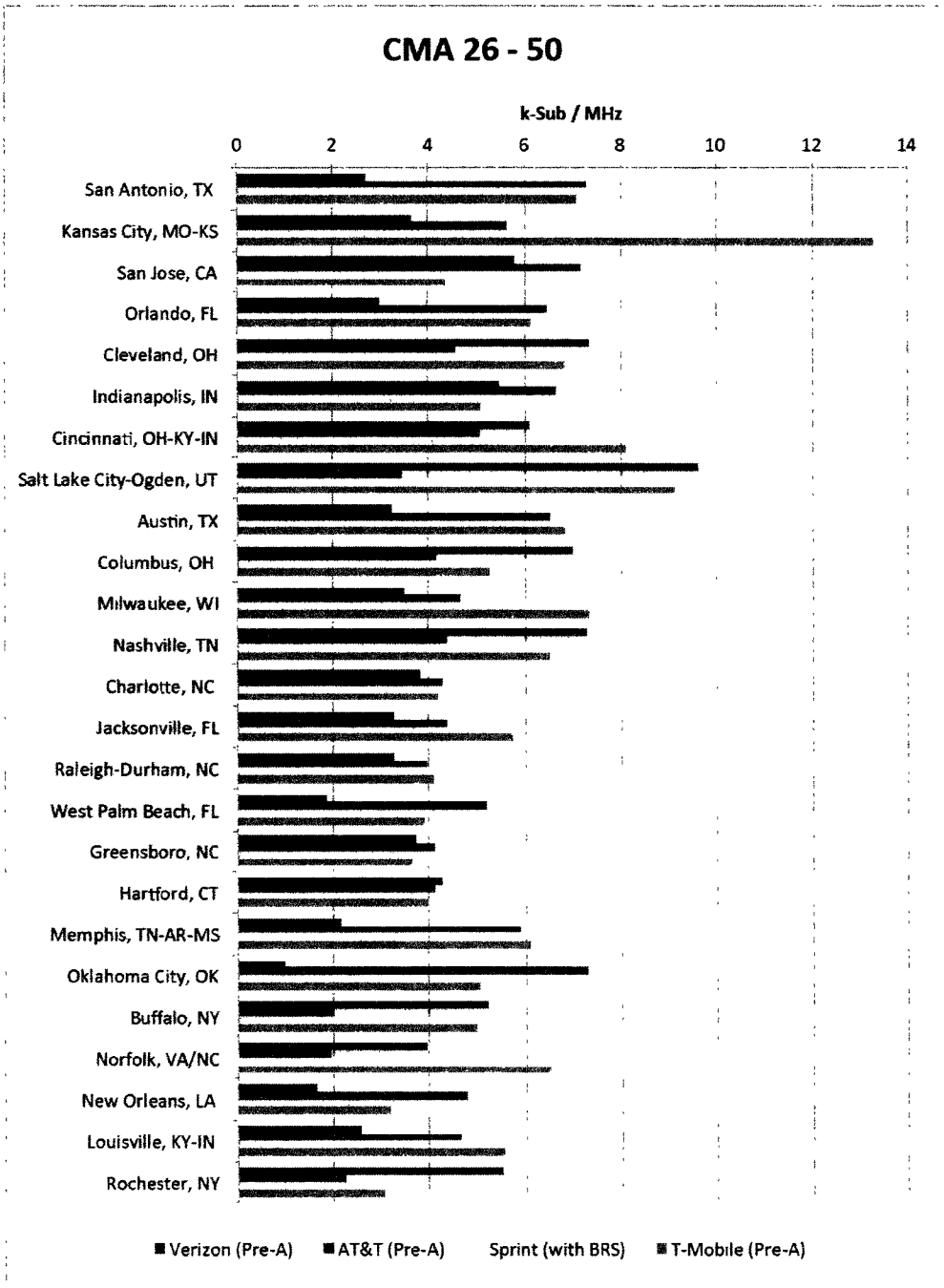


Figure 6: Scenario 2, Metric E_1 (Corrections: SP Data-YES, SP Mix-YES, Spectrum-NO)